PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-045740

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H01G 4/12

(21)Application number : 2001-229697

(22)Date of filing : 30.07.2001

(71)Applicant : KYOCERA CORP

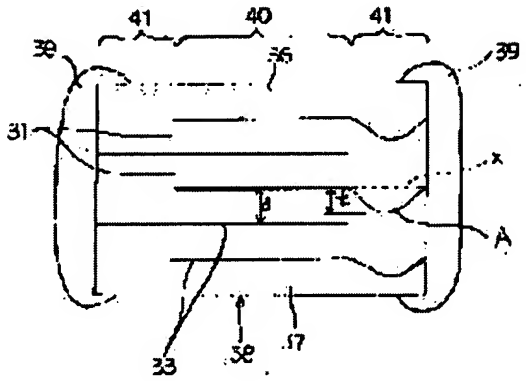
(72)Inventor : OOTA HITOSHI

(54) LAMINATED ELECTRONIC COMPONENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a laminated electronic component which can improve thermal shock resistance, even when a thin dielectric material layer is formed and the number of laminated layers is increased.

SOLUTION: This laminated electronic component comprises an electronic component body 38, where a plurality of dielectric material layers 31 and a plurality of internal electrodes 33 are laminated alternately, and capacitance non-generating portions 41 are formed on both sides of a capacitance generating portion 40, which generates capacitance and external electrodes 39, which are formed respectively to both end faces of the electronic component body 38 and are alternately connected to the internal electrodes 33, via the capacitance non-generating portions 41. A curved portion A is formed to the internal electrodes 33 of the capacitance non-generating portion 41 which is formed to either side of the capacitance generating portion 40.



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[Date of request for examination] 15.04.2002

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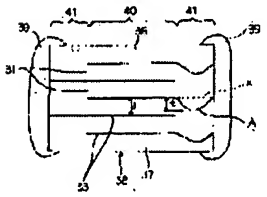

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a laminated electronic component which can improve thermal shock resistance, even when a thin dielectric material layer is formed and the number of laminated layers is increased.

SOLUTION: This laminated electronic component comprises an electronic component body 38, where a plurality of dielectric material layers 31 and a plurality of internal electrodes 33 are laminated alternately, and capacitance non-

generating portions 41 are formed on both sides of a capacitance generating portion 40, which generates capacitance and external electrodes 39, which are formed respectively to both end faces of the electronic component body 38 and are alternately connected to the internal electrodes 33, via the capacitance non-generating portions 41. A curved portion A is formed to the internal electrodes 33 of the capacitance non-generating portion 41 which is formed to either side of the capacitance generating portion 40.

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* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] The body of electronic parts with which capacity the non-generating section was formed in the both sides of the capacity generating section which it comes [section] to carry out the laminating of two or more dielectric layers and two or more internal electrodes by turns, and generates capacity, In the laminating mold electronic parts possessing the external electrode to which it was formed in the both-ends side of this body of electronic parts, respectively, and said internal electrode was connected by turns through said capacity non-generating section Laminating mold electronic parts characterized by forming the bend in the internal electrode of the capacity the non-generating section formed in either of said capacity generating sections.

[Claim 2] Bend edges are laminating mold electronic parts according to claim 1 characterized by existing near the production of the internal electrode of the capacity generating section.

[Claim 3] The bend of an internal electrode is claim 1 characterized by curving in the direction of a laminating from on the production of the internal electrode of the capacity generating section in 0.5 to 1 time as many dielectric thickness Mino as this, and laminating mold electronic parts given in two.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the laminating mold electronic parts suitable for a stacked type ceramic condenser, concerning laminating mold electronic parts.

[0002]

[Description of the Prior Art] As shown in drawing 4 , the conventional stacked type ceramic condenser formed the external electrode 9 in the both ends of the body 8 of electronic parts which carries out the laminating of two or more dielectric layers 1 and the internal electrode 3 of the shape of two or more rectangle by turns, and becomes, and was constituted.

[0003] A different polar internal electrode 3 superimposes the body 8 of electronic parts, it consists of the capacity generating section 10 which generates capacity substantially, and capacity the non-generating section 11 formed in the both sides, and the internal electrode 3 is connected to the external electrode 9 formed in the both ends of the body 8 of electronic parts, respectively through the capacity non-generating section 11 for every layer.

[0004] And the internal electrode 3 in each the capacity non-generating section 11 was conventionally crooked towards one side by passing through the press

process and decision process of a laminate-molding object (refer to JP,11-54365,A and JP,8-148371,A).

[0005]

[Problem(s) to be Solved by the Invention] However, in the conventional laminating mold electronic parts, based on the internal electrode pattern thickness formed on the green sheet, it was easy to produce peeling, the internal electrode 3 in each the capacity non-generating section 11 was crooked towards one side by the production process, and there was a problem of being easy to generate a crack.

[0006] In order to solve such a problem, it sets at recent years. Form two or more internal electrode patterns on the green sheet which forms a dielectric layer, and it is filled up with an insulating paste between these internal electrode patterns. By carrying out two or more laminatings of the green sheet with which the dielectric pattern of the same thickness was mostly formed with this internal electrode pattern, and such an internal electrode pattern and the dielectric pattern were formed between internal electrode patterns, and cutting and calcinating it in a predetermined location Making flat the internal electrode of the capacity generating section and the internal electrode of the capacity the non-generating section is performed (refer to JP,2000-311831,A).

[0007] Although peeling at the time of the manufacture based on internal electrode thickness and the crack initiation after baking can be controlled in such laminating mold electronic parts since the internal electrode of the capacity generating section and the internal electrode of the capacity the non-generating section are formed in the shape of flatness Since contraction of an internal electrode pattern and the dielectric pattern filled up with and formed between this internal electrode pattern is different, Although it was hard to generate a crack after baking, there was a problem that the internal stress based on a contraction difference occurred, and a crack occurred at low temperature comparatively in a heat-resistant impact test.

[0008] That is, the internal electrode pattern was a paste containing metal

powder, and on the other hand, since a dielectric pattern was a paste containing ceramic powder, it had the problem that differed, the internal stress of the direction center section of a laminating of the dielectric layer in electronic parts became large, and the crack which met the internal electrode of the direction center section of a laminating generated contraction at the time of baking at low temperature in a heat-resistant impact test. The more the dielectric layer became thin, the more such internal stress had the problem of becoming large indeed, when the number of laminatings increased.

[0009] This invention aims at offering the laminating mold electronic parts which can improve thermal shock resistance, even when lamination of the dielectric layer is carried out and the number of laminatings is increased.

[0010]

[Means for Solving the Problem] The body of electronic parts with which capacity the non-generating section was formed in the both sides of the capacity generating section which the laminating mold electronic parts of this invention come [section] to carry out the laminating of two or more dielectric layers and two or more internal electrodes by turns, and generates capacity, In the laminating mold electronic parts possessing the external electrode to which it was formed in the both-ends side of this body of electronic parts, respectively, and said internal electrode was connected by turns through said capacity non-generating section It is characterized by forming the bend in the internal electrode of the capacity the non-generating section formed in either of said capacity generating sections.

[0011] Since the bend is formed in the internal electrode of the capacity the non-generating section formed in either of the capacity generating sections in such laminating mold electronic parts, By the differential shrinkage of the electrode metal powder produced at the time of sintering, and the ceramic powder with which it was filled up that there is no clearance between electrode patterns, control internal stress generating generated inside the body of electronic parts, and thermal shock resistance is improved. While being able to control the crack

initiation which met the internal electrode of the direction center section of a laminating of the body of electronic parts, the crack initiation which met the internal electrode of the outermost layer can be controlled.

[0012] Moreover, the laminating mold electronic parts of this invention are characterized by a bend edge existing on the production of the internal electrode of the capacity generating section. While being able to strengthen by this junction of the dielectric layers of the end face in which the external electrode of the body of electronic parts is formed, appearance deformation of the body of electronic parts can be controlled.

[0013] Furthermore, the laminating mold electronic parts of this invention are characterized by the bend of an internal electrode curving in the direction of a laminating from on the production of the internal electrode of the capacity generating section in 0.5 to 1 time as many dielectric thickness Mino as this. While being able to improve insulation with the internal electrode with which the polarities which carry out proximal differ by this, internal stress generating of the body of electronic parts can be controlled effectively.

[0014]

[Embodiment of the Invention] A stacked type ceramic condenser is made into an example, and the laminating mold electronic parts of this invention are explained. As shown in drawing 1 , the top end-face ceramic layer 36 and the bottom end-face ceramic layer 37 are formed in the vertical side of the layered product which comes by turns to carry out the laminating of the internal electrode 33 of two or more shape of a rectangle which has a dielectric layer 31, and two or more long sides and shorter sides, the body 38 of electronic parts is constituted, and the stacked type ceramic condenser of this invention forms the external electrode 39 in the both ends of this body 38 of electronic parts, and is constituted.

[0015] 5 micrometers or less especially of thickness of two or more dielectric layers 31 are set to 3 micrometers or less, and 3 micrometers or less especially of thickness of an internal electrode 33 are made or less into two, and small thin shape-ization of laminating mold electronic parts is attained. In this invention,

from a viewpoint that the differential shrinkage of an internal electrode pattern and the ceramic pattern between this internal electrode pattern becomes large, when the thickness of 3 micrometers or less, especially an internal electrode has the thickness of a dielectric layer thicker than the thickness of a dielectric layer, it is used suitably.

[0016] A different polar internal electrode 33 superimposes the body 38 of electronic parts, it consists of the capacity generating section 40 which generates capacity substantially, and capacity the non-generating section 41 formed in the both sides, and the internal electrode 33 is connected to the external electrode 39 formed in the both-ends side of the body 38 of electronic parts, respectively through the capacity non-generating section 41 for every layer.

[0017] As the edge of an internal electrode 33 was shown in drawing 1 , it has exposed to the both-ends side of the body 38 of electronic parts by turns through the capacity non-generating section 41, and the edge of these internal electrodes 33 is connected to the external electrode 39.

[0018] And Bend A is formed in the internal electrode 33 in one the capacity non-generating section 41, and the internal electrode 33 in the capacity non-generating section 41 of another side is made almost flat. The edge of Bend A exists in about x production of the internal electrode 33 of the capacity generating section 41, and the bend A of an internal electrode 33 is curving by one 0.5 to 1 time the amount t of curves of dielectric bed-depth d in the direction of a laminating from the production x of the internal electrode 33 of the capacity generating section 40.

[0019] It is because it has the thermal shock resistance which peeling did not occur, but could secure insulation with the internal electrode 33 which carries out proximal, and was excellent in buckling within the limits of this at the time of manufacture to have made the bend A of an internal electrode 33 curve by one 0.5 to 1 time the distance t of dielectric bed-depth d. On the other hand, the amount t of curves is because there is an inclination for thermal shock resistance to fall, peeling occurs or there is an inclination for thermal shock resistance to fall,

at the time of manufacture, in being larger than dielectric bed-depth d when dielectric bed-depth d is smaller than 0.5 times. It is desirable that they are 0.5 to 0.7 times from the point of the amount t of curves improving the insulation between the internal electrodes 33 with which the polarities which carry out proximal differ, and improving thermal shock resistance.

[0020] It is important for the amount t of curves of this invention circular and that in other words are a segment-like and a bend A edge is returning [a configuration] to about x production of an internal electrode 33.

[0021] The process of the stacked type ceramic condenser of this invention is explained. First, on the carrier film 52, a ceramic slurry is applied and the ceramic green sheet 51 which constitutes a dielectric layer is formed, as shown in drawing 2 (a).

[0022] Using that with which the ceramic slurry mixed MgCO3, MnCO3, and 2OY3 powder for example, to BaTiO3 powder as ceramic powder, as an organic binder, for example, butyral resin uses, and toluene uses and it is produced as a solvent.

[0023] Next, on the principal plane of this ceramic green sheet 51, conductive paste is printed, the internal electrode pattern 53 sets predetermined spacing, and two or more formation is carried out. As conductive paste, it is produced, for example, using a hydrocarbon system solvent as a solvent, using ethyl cellulose as nickel powder, BaTiO3 powder, and an organic binder.

[0024] Then, between the internal electrode patterns 53, a ceramic paste is printed so that the level difference by the thickness of this internal electrode pattern 53 may be lost substantially, for example, the ceramic pattern 55 of the same thickness is substantially formed with the thickness of the internal electrode pattern 53.

[0025] Under the present circumstances, as shown in drawing 2 (a) and (c), the ceramic pattern 55 needs to control and print a ceramic paste so that the one side edge of the longitudinal direction between the internal electrode patterns 53 may not be laid underground and it may have Opening E. In addition, about the

thickness of the ceramic pattern 55, even if it is not the same thickness, it does not matter even if a little thin.

[0026] Next, on an end-face ceramic green sheet, as shown in drawing 2 (b), two or more laminatings of the ceramic green sheet 51 in which the internal electrode pattern 53 and the ceramic pattern 55 were formed are carried out, the laminating of the end-face ceramic green sheet is carried out to the maximum top face, and the parent layered product 59 is produced. In addition, drawing 2 (b) indicated a part of parent layered product 59.

[0027] Then, the parent layered product 59 is laid in metal mold, and in the condition of having heated to predetermined temperature, from a laminating, it pressurizes with a press machine and is stuck by pressure. Under the present circumstances, as shown in drawing 2 (d), the part of the internal electrode pattern formed on the green sheet with which the green sheet located in the top face of Opening E was curved, buried and buried in Opening E curves, but since the part of other green sheets is not buried, the bend A edge is located near the production of an internal electrode pattern. About the amount t of curves of Bend A, it is controllable by the width of face of Opening E, the thickness of the ceramic pattern 55, width of face, etc.

[0028] Next, as shown in drawing 2 , the part shown with a broken line is cut and a ceramic layered product Plastic solid is produced. In the case of cutting of the parent layered product 59, cutting removal is carried out so that the edge of the internal electrode pattern 53 may be exposed by turns.

[0029] Then, the stacked type ceramic condenser of this invention is produced by calcinating a ceramic laminate-molding object on the bottom of a predetermined ambient atmosphere, and predetermined temperature conditions, producing two or more bodies 38 of electronic parts, applying the external electrode paste containing nickel to the both-ends side of the body 38 of electronic parts, and being burned on it after this.

[0030] As mentioned above, since Bend A is formed in the internal electrode 33 of the capacity non-generating section 41 formed in either of the capacity

generating sections 40 in this invention, internal stress generating generated in the body of electronic parts 38 interior is controlled, thermal shock resistance is improved, and while being able to control the crack initiation which met the internal electrode 33 of the direction center section of a laminating of the body 38 of electronic parts, the crack initiation which met the internal electrode 33 of the outermost layer can be controlled.

[0031] Namely, since contraction differs as the internal electrode pattern and the ceramic pattern were described above when it is completely filled up with a ceramic paste between the conventional internal electrode patterns, Although big internal stress will occur in the interface of an internal electrode pattern and a ceramic pattern at the time of baking if these exist between green sheets In the invention in this application, since [of an internal electrode pattern] Opening E is formed between the edge and the ceramic pattern on the other hand, the internal stress based on the contraction difference of an internal electrode pattern and a ceramic pattern can be eased by this opening E.

[0032] Moreover, the internal electrode 33 of the capacity non-generating section 41 with which Bend A is not formed is flat, and in the capacity non-generating section 41 in which Bend A is formed, it can control appearance deformation of the body 38 of electronic parts while being able to strengthen junction of dielectric layer 31 comrades of the end face in which the external electrode 39 of the body 38 of electronic parts is formed, since a bend A edge is near the production of an internal electrode 33.

[0033] Furthermore, since the ceramic pattern 55 is formed between the internal electrode patterns 53, effect of the level difference by the thickness of the internal electrode pattern 53 can be made small, and even if it can carry out the laminating of the ceramic green sheet 51, it makes thin thickness of the internal electrode pattern 53 or the ceramic green sheet 51 and it promotes small thin shape-ization in the condition of not being influenced of the thickness of the internal electrode pattern 53, deformation of the body of electronic parts can be controlled.

[0034]

[Example] The stacked type ceramic condenser which is one of the laminating mold electronic parts was produced as follows.

[0035] As opposed to the 100 mol section of constituents which consists of BaTiO399.5 mol % and MnO0.5 mol % In Y2O3, carry out 0.5-mol section addition and these ceramic component 100 weight sections are received [MgO / the 0.5 mol section and]. The vehicle 55 weight section which consists of 5.5 % of the weight of ethyl cellulose and 94.5 % of the weight of petroleum system alcohol is added. It kneaded and prepared with 3 rolls, the ceramic slurry was created, membranes were formed on the band-like carrier film which consists of polyester using the die coating-machine method, and the ceramic green sheet was produced.

[0036] 55 % of the weight of vehicles which consist conductive paste of 45 % of the weight of nickel powder with a particle diameter of 0.2 micrometers, and 5.5 % of the weight of ethyl cellulose and 94.5 % of the weight of petroleum system alcohol was kneaded and prepared with 3 rolls.

[0037] Moreover, the ceramic paste for ceramic patterns ground a part of above-mentioned ceramic slurry until the mean particle diameter of BaTiO3 was set to 0.5 micrometers, and it was pasted like conductive paste and it prepared it.

[0038] Next, used screen-stencil equipment, the rectangle-like pattern configuration was made to print and dry the above-mentioned conductive paste in the shape of [of the obtained ceramic green sheet] a principal plane, and the internal electrode pattern of the average thickness shown in Table 1 was formed. The distance with the internal electrode pattern which carries out proximal in the die-length direction of an internal electrode pattern was 500 micrometers.

[0039] Furthermore, between the internal electrode patterns formed on this ceramic green sheet, the screen printer was used, the ceramic paste was printed and dried so that only one longitudinal direction edge and spacing L (120 micrometers) of an internal electrode pattern might be estranged, as shown in drawing 2 (a), and the ceramic pattern of the thickness shown in Table 1 with an

internal electrode pattern produced the ceramic green sheet by which spreading formation was carried out.

[0040] Next, the 300-layer laminating of this ceramic green sheet was carried out, further, the ten-sheet each laminating of that ceramic green sheet with which the internal electrode pattern and the ceramic pattern are not formed up and down was carried out, the pressurization press was performed, and the temporary layered product was formed.

[0041] The temporary layered product produced on this condition is in the condition of not being completely stuck to the ceramic green sheet, and few openings E were formed in the part surrounded with an internal electrode pattern, a ceramic pattern, and a green sheet.

[0042] Next, the 2nd laminating press was performed for this temporary layered product by the temperature of 100 degrees C, and pressure 20MPa, the laminating of the ceramic green sheet which consists of the same ingredient as the ceramic green sheet which applied the internal electrode pattern, and the ceramic green sheet of those upper and lower sides was carried out, it was stuck completely, and the parent layered product was obtained. Opening E was fully able to perform degassing at the time of a press.

[0043] In the capacity agenesis section of one side, on the other hand, since [of the ceramic green sheet in which the internal electrode pattern was formed] the ceramic pattern was formed in a principal plane with the internal electrode pattern, in this laminating press process, deformation of the ceramic green sheet by heating pressurization or an internal electrode pattern did not arise in it, and the parent layered product was able to form the parent layered product in it. In the capacity agenesis section of another side, since the opening E between internal electrode patterns was narrowed conventionally, the bend has been formed in the internal electrode pattern.

[0044] Next, this parent layered product was cut in the shape of a grid, and the ceramic layered product Plastic solid was acquired. The end of an internal electrode pattern was exposed to the both-ends side of this ceramic layered

product Plastic solid by turns.

[0045] Next, this ceramic layered product Plastic solid was heated at 500 degrees C among atmospheric air among oxygen / nitrogen-gas-atmosphere mind (250 degrees C or 0.1Pa), and deBAI processing was performed.

[0046] Furthermore, to the ceramic layered product Plastic solid after deBAI, it calcinated at 1250 degrees C for 2 hours among the oxygen / nitrogen-gas-atmosphere mind of ten to 7 Pa, and further, reoxidation processing of 4 hours was performed at 900 degrees C in the oxygen nitrogen-gas-atmosphere mind of ten to 2 Pa, and the body of electronic parts was acquired. Cu paste could be burned on the end face of the body of electronic parts at 900 degrees C after baking, nickel/Sn plating was performed further, and the external electrode linked to an internal electrode was formed.

[0047] Thus, the dimension of the obtained stacked type ceramic condenser was 2mm in width of face of 1mm, and die length.

[0048] Next, the cross section of the obtained stacked type ceramic condenser was observed, the amount t of curves was computed in the direction of a laminating from on the curve situation of an internal electrode, and the production of the internal electrode of the capacity generating section, and it asked for the ratio to a dielectric bed depth. Moreover, peeling of the end face of the ceramic layered product Plastic solid after the cut of a parent layered product was observed and evaluated by the 40 times as many binocular microscope as this about 300 parent layered products. Furthermore, it was immersed in the solder tub which set the stacked type ceramic condenser as the temperature of arbitration for 1 second, the thermal-shock-resistance trial was performed, and the temperature which a crack generates on the side face of a capacitor was measured.

[0049] Moreover, except not forming a ceramic pattern between internal electrode patterns, the stacked type ceramic condenser of the example of a comparison shown in drawing 4 was produced like the above, and it indicated to No.1 of Table 1. Furthermore, the both sides of the longitudinal direction of an

internal electrode pattern formed the ceramic pattern so that Opening E might not be formed, they produced the laminating mold electronic parts of the example of a comparison all whose internal electrodes are flatness, and were indicated to No.7 of Table 1. It examined by observing about these as well as the above. These results are also indicated to Table 1.

[0050]

[Table 1]

試料 No.	内部電極 パターン厚み μm	セラミックパターン 厚み μm	電極湾曲 発生状態	誘電体層 厚み μm	湾曲率 倍	剥がれ 発生率 (%)	クラック発生 温度 (℃)
*1	3	—	両側湾曲	4	2	50	275 ✓
2	3	1	片側湾曲	4	1	0	350
3	3	1.5	片側湾曲	4	0.7	0	350
4	3	2	片側湾曲	4	0.5	0	350
5	3	2.5	片側湾曲	4	0.3	0	325
6	3	3	片側湾曲	4	0.1	0	300
*7	3	5	発生なし	4	0	0	275 ✓
8	3	2	片側湾曲	3	0.5	0	330
9	3	2	片側湾曲	2	0.5	0	320

*印は本発明の範囲外の試料を示す。

[0051] From this table 1, a crack hardly occurred in an end face by the sample of this invention, but the crack initiation temperature in a thermal-shock-resistance trial was also as high as 300 degrees C or more. On the other hand, in sample No.1, the flection is formed in the both sides of an internal electrode, the adhesion of the maximum upper internal electrode and the end-face dielectric layer of the top face fell, and the crack which met the maximum upper internal electrode as low temperature showed to drawing 3 (a) comparatively by the heat-resistant impact test occurred.

[0052] Moreover, the ceramic paste was completely filled up with sample No.7 between internal electrode patterns, and a bend did not occur on both sides of an internal electrode in them. In this case, from the difference in contraction in the ceramic paste and internal electrode pattern at the time of baking, internal stress occurred in the direction center section of a laminating, and in the heat-resistant impact test, comparatively, at low temperature, as shown in drawing 3 (b), the crack occurred along with the internal electrode of the direction center section of

a laminating.

[0053]

[Effect of the Invention] Since the bend is formed in the internal electrode of the capacity the non-generating section formed in either of the capacity generating sections according to this invention as explained in full detail above, internal stress generating generated inside the body of electronic parts is controlled, thermal shock resistance is improved, and while being able to control the crack initiation which met the internal electrode of the direction center section of a laminating of the body of electronic parts, the crack initiation which met the internal electrode of the outermost layer can be controlled.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the laminating mold electronic parts of this invention.

[Drawing 2] (a) - (c) is process drawing for explaining the production process of the laminating mold electronic parts of this invention, and (d) is an explanatory view explaining the situation that an internal electrode pattern curves after a

press.

[Drawing 3] sample No. -- it is the explanatory view showing the crack initiation location of 1 and 7.

[Drawing 4] It is the sectional view showing the conventional laminating mold electronic parts.

[Description of Notations]

31 ... Dielectric layer

33 ... Internal electrode

39 ... External electrode

40 ... Capacity generating section

41 ... Capacity the non-generating section

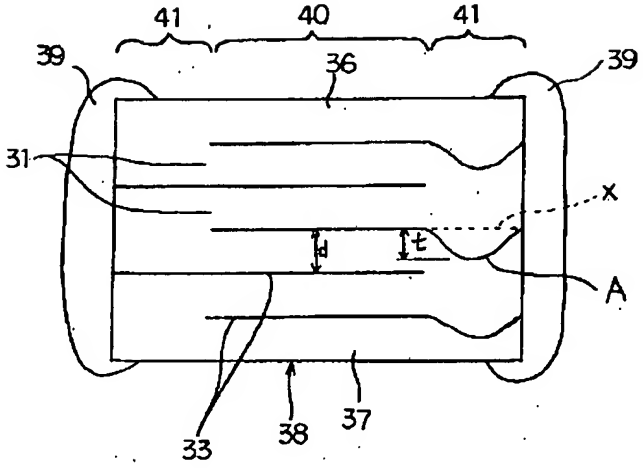
A ... Bend

X ... Production of an internal electrode

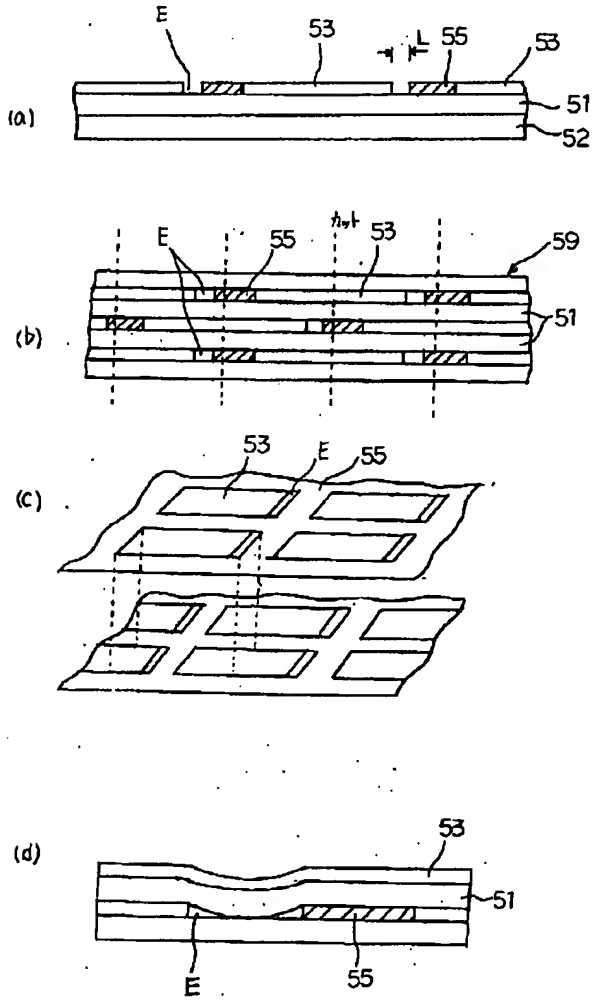
[Translation done.]

DRAWINGS

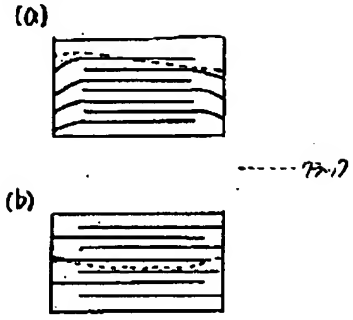
[Drawing 1]



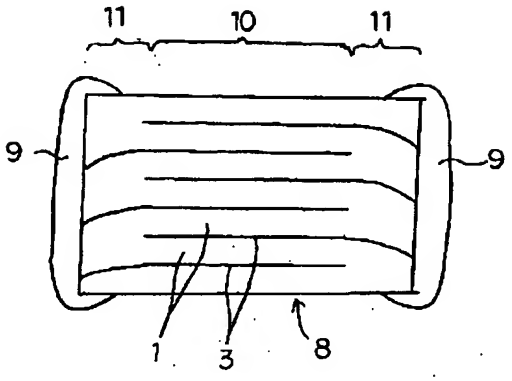
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

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Ｆターム(参考)　5E001 AB03 AC07 AD01 AD02
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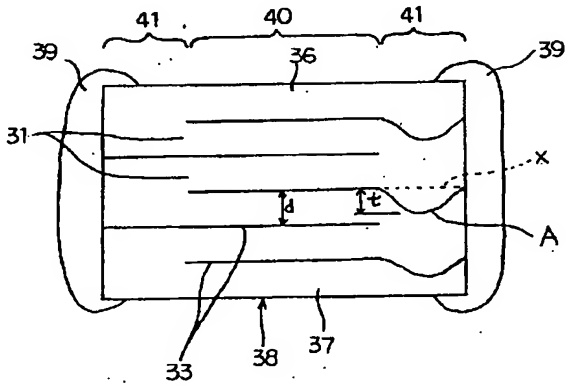
PP09

(54)【発明の名称】　積層型電子部品

(57)【要約】
【課題】誘電体層を薄層化して積層数を増加した場合でも、耐熱衝撃性を向上できる積層型電子部品を提供する。
【解決手段】複数の誘電体層３１と複数の内部電極３３とを交互に積層してなり、容量を発生させる容量発生部４０の両側に容量非発生部４１が形成された電子部品本体３８と、該電子部品本体３８の両端面にそれぞれ形成され、内部電極３３が容量非発生部４１を介して交互に接続された外部電極３９とを具備する積層型電子部品において、容量発生部４０のいずれか一方に形成された容量非発生部４１の内部電極３３に湾曲部Ａが形成されている。



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【特許請求の範囲】
【請求項１】複数の誘電体層と複数の内部電極とを交互に積層してなり、容量を発生させる容量発生部の両側に容量非発生部が形成された電子部品本体と、該電子部品本体の両端面にそれぞれ形成され、前記内部電極が前記容量非発生部を介して交互に接続された外部電極とを具備する積層型電子部品において、前記容量発生部のいずれか一方に形成された容量非発生部の内部電極に湾曲部が形成されていることを特徴とする積層型電子部品。
【請求項２】湾曲部端は、容量発生部の内部電極の延長線近傍に存在することを特徴とする請求項１記載の積層型電子部品。
【請求項３】内部電極の湾曲部は、容量発生部の内部電極の延長線上から積層方向に誘電体層厚みの０．５～１倍で湾曲していることを特徴とする請求項１又２記載の積層型電子部品。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、積層型電子部品に関し、例えば、積層セラミックコンデンサに適する積層型電子部品に関するものである。
【０００２】
【従来技術】従来の積層セラミックコンデンサは、図４に示すように、複数の誘電体層１と複数の長方形状の内部電極３を交互に積層してなる電子部品本体８の両端部に外部電極９を設けて構成されていた。
【０００３】電子部品本体８は、異なる極性の内部電極３が重畳し、実質的に容量を発生させる容量発生部１０と、その両側に形成された容量非発生部１１とから構成され、電子部品本体８の両端部にそれぞれ形成された外部電極９には、内部電極３が一層毎に容量非発生部１１を介して接続されている。
【０００４】そして、従来、各容量非発生部１１における内部電極３は、積層成形体のプレス工程や裁断工程を経ることによって、一方側に向けて屈曲していた（特開平１１－５４３６５号、特開平８－１４８３７１号公報参照）。
【０００５】
【発明が解決しようとする課題】しかしながら、従来の積層型電子部品では、グリーンシート上に形成された内部電極パターン厚みに基づき、製造工程で剥がれが生じ易く、各容量非発生部１１における内部電極３が一方側に向けて屈曲し、クラックが発生し易いという問題があった。
【０００６】このような問題を解決するため、近年においては、誘電体層を形成するグリーンシート上に複数の内部電極パターンを形成し、該内部電極パターン間に絶縁ペーストを充填して、内部電極パターン間に、この内部電極パターンとほぼ同一厚みの誘電体パターンを形成し、このような内部電極パターンと誘電体パターンが形

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成されたグリーンシートを複数積層し、所定位置で切断し、焼成することにより、容量発生部の内部電極と容量非発生部の内部電極を平坦にすることが行われている（特開２０００－３１１８３１号公報参照）。
【０００７】このような積層型電子部品では、容量発生部の内部電極と容量非発生部の内部電極が平坦状に形成されているため、内部電極厚みに基づく製造時における剥がれや、焼成後におけるクラック発生を抑制することができるが、内部電極パターンと、この内部電極パターン間に充填して形成される誘電体パターンの収縮率が相違するため、焼成後にクラックは発生しにくいものの、収縮率相違に基づく内部応力が発生し、耐熱衝撃試験において比較的低温でクラックが発生するという問題があった。
【０００８】即ち、内部電極パターンは、金属粉末を含有したペーストであり、一方、誘電体パターンはセラミック粉末を含有したペーストであるため、焼成時における収縮率が異なり、電子部品における誘電体層の積層方向中央部の内部応力が大きくなり、耐熱衝撃試験において、積層方向中央部の内部電極に沿ったクラックが低温で発生するという問題があった。このような内部応力は、誘電体層が薄くなればなるほど、積層数が多くなればなるほど大きくなるという問題があった。
【０００９】本発明は、誘電体層を薄層化して積層数を増加した場合でも、耐熱衝撃性を向上できる積層型電子部品を提供することを目的とする。
【００１０】
【課題を解決するための手段】本発明の積層型電子部品は、複数の誘電体層と複数の内部電極とを交互に積層してなり、容量を発生させる容量発生部の両側に容量非発生部が形成された電子部品本体と、該電子部品本体の両端面にそれぞれ形成され、前記内部電極が前記容量非発生部を介して交互に接続された外部電極とを具備する積層型電子部品において、前記容量発生部のいずれか一方に形成された容量非発生部の内部電極に湾曲部が形成されていることを特徴とする。
【００１１】このような積層型電子部品では、容量発生部のいずれか一方に形成された容量非発生部の内部電極に湾曲部が形成されているため、焼結時に生じる電極金属粉末と電極パターン間に隙間無く充填したセラミック粉末の収縮差によって電子部品本体内部に発生する内部応力発生を抑制して耐熱衝撃性を向上し、電子部品本体の積層方向中央部の内部電極に沿ったクラック発生を抑制できるとともに、最外層の内部電極に沿ったクラック発生を抑制できる。
【００１２】また、本発明の積層型電子部品は、湾曲部端は、容量発生部の内部電極の延長線上に存在することを特徴とする。これにより、電子部品本体の外部電極が形成される端面の誘電体層同士の接合を強固にできるとともに、電子部品本体の外形変形を抑制できる。

【００１３】さらに、本発明の積層型電子部品は、内部電極の湾曲部は、容量発生部の内部電極の延長線上から積層方向に誘電体層厚みの０．５～１倍で湾曲していることを特徴とする。これにより、隣設する極性の異なる内部電極との絶縁性を向上できるとともに、電子部品本体の内部応力発生を有効に抑制できる。

【００１４】

【発明の実施の形態】本発明の積層型電子部品を、例えば、積層セラミックコンデンサを例にして説明する。本発明の積層セラミックコンデンサは、図１に示すように、複数の誘電体層３１と、長辺と短辺を有する複数の長方形状の内部電極３３を交互に積層してなる積層体の上下面に、上側端面セラミック層３６および下側端面セラミック層３７が形成されて、電子部品本体３８が構成されており、この電子部品本体３８の両端部に外部電極３９を設けて構成されている。

【００１５】複数の誘電体層３１の厚みは、５μｍ以下、特には３μｍ以下とされており、また、内部電極３３の厚みは３μｍ以下、特には２以下とされ、積層型電子部品の小型薄型化が図られている。本発明では、内部電極パターンと、この内部電極パターン間のセラミックパターンの収縮差が大きくなるという観点から、誘電体層の厚みが３μｍ以下、特に内部電極の厚みが誘電体層の厚みよりも厚い場合に好適に用いられる。

【００１６】電子部品本体３８は、異なる極性の内部電極３３が重畳し、実質的に容量を発生させる容量発生部４０と、その両側に形成された容量非発生部４１とから構成され、電子部品本体３８の両端面にそれぞれ形成された外部電極３９には、内部電極３３が一層毎に容量非発生部４１を介して接続されている。

【００１７】内部電極３３の端部は、図１に示したように、容量非発生部４１を介して電子部品本体３８の両端面に交互に露出しており、これらの内部電極３３の端部が外部電極３９に接続されている。

【００１８】そして、一方の容量非発生部４１における内部電極３３には湾曲部Ａが形成されており、他方の容量非発生部４１における内部電極３３はほぼ平坦とされている。湾曲部Ａの端は、容量発生部４１の内部電極３３の延長線ｘ近傍に存在しており、内部電極３３の湾曲部Ａは、容量発生部４０の内部電極３３の延長線ｘから積層方向に誘電体層厚みｄの０．５～１倍の湾曲量ｔで湾曲している。

【００１９】内部電極３３の湾曲部Ａを誘電体層厚みｄの０．５～１倍の距離ｔで湾曲せしめたのは、この範囲内の湾曲率では製造時に剥がれが発生せず、隣設する内部電極３３との絶縁性を確保でき、優れた耐熱衝撃性を有するからである。一方、湾曲量ｔが誘電体層厚みｄの０．５倍よりも小さい場合には耐熱衝撃性が低下する傾向があり、誘電体層厚みｄよりも大きい場合には、製造時に剥がれが発生したり、耐熱衝撃性が低下する傾向があるからである。湾曲量ｔは、隣設する極性の異なる内部電極３３間の絶縁性を向上し、耐熱衝撃性を向上するという点から０．５～０．７倍であることが望ましい。

【００２０】本発明の湾曲量ｔは、形状が円弧状、言い換えれば弓形状であり、湾曲部Ａ端が、内部電極３３の延長線ｘ近傍まで戻ってきていることが重要である。

【００２１】本発明の積層セラミックコンデンサの製法について説明する。誘電体層を構成するセラミックグリーンシート５１は、図２（ａ）に示すように、まず、キャリアフィルム５２上にセラミックスラリを塗布して形成される。

【００２２】セラミックスラリは、セラミック粉末として、例えば、$BaTiO_3$粉末に$MgCO_3$、$MnCO_3$、Y_2O_3粉末を混合したものを用い、有機バインダーとしては、例えば、ブチラール樹脂が用い、溶剤としてはトルエンが用いて作製される。

【００２３】次に、このセラミックグリーンシート５１の主面上に導体ペーストを印刷して内部電極パターン５３が所定間隔をおいて複数形成される。導体ペーストとしては、例えば、Ｎｉ粉末、$BaTiO_3$粉末、有機バインダーとしては、例えば、エチルセルロースを用い、溶剤としては炭化水素系溶剤を用いて作製される。

【００２４】この後、内部電極パターン５３の間に、この内部電極パターン５３の厚みによる段差を実質的に無くすようにセラミックペーストを印刷し、例えば内部電極パターン５３の厚みと実質的に同一厚みのセラミックパターン５５が形成される。

【００２５】この際、セラミックパターン５５は、図２（ａ）（ｃ）に示すように、内部電極パターン５３間の長手方向の一方側端が埋設されないように空隙Ｅを有するように、セラミックペーストを制御して印刷する必要がある。尚、セラミックパターン５５の厚みについては、同一厚みでなくても、少々薄くても構わない。

【００２６】次に、端面セラミックグリーンシートの上に、図２（ｂ）に示すように、内部電極パターン５３およびセラミックパターン５５を形成したセラミックグリーンシート５１を複数積層し、最上面に端面セラミックグリーンシートを積層し、母体積層体５９を作製する。尚、図２（ｂ）では、母体積層体５９の一部のみ記載した。

【００２７】この後、母体積層体５９を金型に載置し、所定温度に加熱した状態で、積層方向からプレス機により加圧して圧着する。この際、図２（ｄ）に示すように、空隙Ｅの上面に位置するグリーンシートが空隙Ｅ内に湾曲して埋没し、埋没したグリーンシート上に形成された内部電極パターンの部分は湾曲するが、その他のグリーンシートの部分は埋没しないため、湾曲部Ａ端は、内部電極パターンの延長線近傍に位置している。湾曲部Ａの湾曲量ｔについては、空隙Ｅの幅、セラミックパターン５５の厚み、幅等によって制御することができる。

【００２８】次に、図２に示すように、破線で示す部分を切断して、セラミック積層体成形体を作製する。母体積層体５９の切断の際には、内部電極パターン５３の端部が交互に露出するように切断除去する。

【００２９】この後、セラミック積層成形体を所定の雰囲気下、所定温度条件で焼成して複数の電子部品本体３８を作製し、この後、電子部品本体３８の両端面に、例えばＮｉを含有する外部電極ペーストを塗布して焼き付けることにより、本発明の積層セラミックコンデンサを作製する。

【００３０】以上のように、本発明では、容量発生部４０のいずれか一方に形成された容量非発生部４１の内部電極３３に湾曲部Ａが形成されているので、電子部品本体３８内部に発生する内部応力発生を抑制して耐熱衝撃性を向上し、電子部品本体３８の積層方向中央部の内部電極３３に沿ったクラック発生を抑制できるとともに、最外層の内部電極３３に沿ったクラック発生を抑制できる。

【００３１】即ち、従来の内部電極パターン間にセラミックペーストを完全に充填した場合、内部電極パターンとセラミックパターンは上記したように収縮率が異なるため、これらがグリーンシート間に存在すると、焼成時に内部電極パターンとセラミックパターンの界面に大きな内部応力が発生するが、本願発明では、内部電極パターンの一方端とセラミックパターンとの間には空隙Ｅが形成されているため、この空隙Ｅにより、内部電極パターンとセラミックパターンの収縮率差に基づく内部応力を緩和することができる。

【００３２】また、湾曲部Ａが形成されていない容量非発生部４１の内部電極３３は平坦であり、また、湾曲部Ａが形成されている容量非発生部４１では、湾曲部Ａ端が、内部電極３３の延長線近傍にあるため、電子部品本体３８の外部電極３９が形成される端面の誘電体層３１同士の接合を強固にできるとともに、電子部品本体３８の外形変形を抑制できる。

【００３３】さらに、内部電極パターン５３間にセラミックパターン５５が形成されているため、内部電極パターン５３の厚みによる段差の影響を小さくでき、内部電極パターン５３の厚みの影響を受けない状態で、セラミックグリーンシート５１を積層することができ、内部電極パターン５３やセラミックグリーンシート５１の厚みを薄くし、小型薄型化を促進したとしても、電子部品本体の変形を抑制できる。

【００３４】

【実施例】積層型電子部品の一つである積層セラミックコンデンサを以下のように作製した。

【００３５】ＢａＴｉＯ$_3$　９９．５モル％と、ＭｎＯ　０．５モル％とからなる組成物１００モル部に対して、Ｙ$_2$Ｏ$_3$を０．５モル部、ＭｇＯを０．５モル部添加し、これらのセラミック成分１００重量部に対して、エチルセルロース５．５重量％と石油系アルコール９４．５重量％からなるビヒクル５５重量部を添加し、３本ロールで混練して調製してセラミックスラリを作成し、ダイコーター法を用いてポリエステルより成る帯状のキャリアフィルム上に成膜し、セラミックグリーンシートを作製した。

【００３６】導体ペーストを、粒子径０．２μｍのＮｉ粉末４５重量％と、エチルセルロース５．５重量％と石油系アルコール９４．５重量％からなるビヒクル５５重量％とを３本ロールで混練して調製した。

【００３７】また、セラミックパターン用のセラミックペーストは、上記のセラミックスラリの一部をＢａＴｉＯ$_3$の平均粒径が０．５μｍになるまで粉砕し、導電ペーストと同様にペースト化して調製した。

【００３８】次に、得られたセラミックグリーンシートの主面状に、スクリーン印刷装置を用いて、上記した導体ペーストを矩形状パターン形状に印刷し、乾燥させ、表１に示す平均厚みの内部電極パターンを形成した。内部電極パターンの長さ方向に隣設する内部電極パターンとの距離は５００μｍであった。

【００３９】さらに、このセラミックグリーンシート上に形成された内部電極パターン間に、図２（ａ）に示すように、内部電極パターンの一方の長手方向端と間隔Ｌ（１２０μｍ）だけ離間するように、スクリーン印刷機を用いてセラミックペーストを印刷、乾燥させ、内部電極パターンとともに、表１に示す厚みのセラミックパターンが塗布形成されたセラミックグリーンシートを作製した。

【００４０】次に、このセラミックグリーンシートを３００層積層し、さらにその上下に、内部電極パターン、セラミックパターンが形成されていないセラミックグリーンシートを各１０枚積層し、加圧プレスを行い、仮積層体を形成した。

【００４１】この条件で作製した仮積層体は、セラミックグリーンシートが完全に密着されていない状態であり、内部電極パターン、セラミックパターンおよびグリーンシートで囲まれる部分に、僅かな空隙Ｅが形成されていた。

【００４２】次に、この仮積層体を温度１００℃、圧力２０ＭＰａで第２回目の積層プレスを行い、内部電極パターンを塗布したセラミックグリーンシートおよびその上下のセラミックグリーンシートと同一材料からなるセラミックグリーンシートを積層して完全に密着させて母体積層体を得た。空隙Ｅによりプレス時の脱気を十分に行うことができた。

【００４３】母体積層体は、一方側の容量非形成部では、内部電極パターンを形成したセラミックグリーンシートの一方主面に、内部電極パターンとともにセラミックパターンを形成しているため、この積層プレス工程において、加熱加圧によるセラミックグリーンシートや内

部電極パターンの変形が生じることが無く母体積層体を形成することができた。他方の容量非形成部では、内部電極パターン間の空隙Ｅが従来よりも狭められているため、内部電極パターンに湾曲部を形成できた。

【００４４】次に、この母体積層体を格子状に切断して、セラミック積層体成形体を得た。このセラミック積層体成形体の両端面には、内部電極パターンの一端が交互に露出していた。

【００４５】次に、このセラミック積層体成形体を大気中２５０℃または０．１Ｐａの酸素／窒素雰囲気中５００℃に加熱し、脱バイ処理を行った。

【００４６】さらに、脱バイ後のセラミック積層体成形体に対して、10^{-7}Ｐａの酸素／窒素雰囲気中、１２５０℃で２時間焼成し、さらに、10^{-3}Ｐａの酸素窒素雰囲気中にて９００℃で４時間の再酸化処理を行い、電子部品本体を得た。焼成後、電子部品本体の端面にＣｕペーストを９００℃で焼き付け、さらにＮｉ／Ｓｎメッキを施し、内部電極と接続する外部電極を形成した。

【００４７】このようにして得られた積層セラミックコンデンサの外形寸法は、幅１ｍｍ、長さ２ｍｍであった。

＊【００４８】次に、得られた積層セラミックコンデンサの断面を観察し、内部電極の湾曲状況、容量発生部の内部電極の延長線上から積層方向へ湾曲量ｔを算出し、誘電体層厚みに対する比率を求めた。また、母体積層体のカット後のセラミック積層体成形体の端面の剥がれを、母体積層体３００個について４０倍の双眼顕微鏡にて観察し、評価した。さらに、積層セラミックコンデンサを任意の温度に設定した半田槽に１秒間浸漬して耐熱衝撃性試験を行い、コンデンサの側面にクラックが発生する温度を測定した。

【００４９】また、内部電極パターン間にセラミックパターンを形成しない以外は上記と同様にして、図４に示す比較例の積層セラミックコンデンサを作製し、表１のＮｏ．１に記載した。さらに、内部電極パターンの長手方向の両側とも、空隙Ｅを形成しないようにセラミックパターンを形成し、内部電極がすべて平坦である比較例の積層型電子部品を作製し、表１のＮｏ．７に記載した。これらについても、上記と同様にして観察し、試験を行った。これらの結果も表１に記載する。

【００５０】

＊【表１】

試料No.	内部電極パターン厚み μm	セラミックパターン厚み μm	電極湾曲発生状態	誘電体層厚み μm	湾曲率 倍	剥がれ発生率 (%)	クラック発生温度 (℃)
*1	3	—	両側屈曲	4	2	50	275 ✓
2	3	1	片側湾曲	4	1	0	350
3	3	1.5	片側湾曲	4	0.7	0	350
4	3	2	片側湾曲	4	0.5	0	350
5	3	2.5	片側湾曲	4	0.3	0	325
6	3	3	片側湾曲	4	0.1	0	300
*7	3	5	発生なし	4	0	0	275 ✓
8	3	2	片側湾曲	3	0.5	0	330
9	3	2	片側湾曲	2	0.5	0	320

*印は本発明の範囲外の試料を示す。

【００５１】この表１から、本発明の試料では、端面にクラックが殆ど発生せず、耐熱衝撃性試験におけるクラック発生温度も３００℃以上と高かった。一方、試料Ｎｏ．１では、内部電極の両側に屈曲部が形成されており、最上層内部電極とその上面の端面誘電体層との密着性が低下し、耐熱衝撃試験にて比較的低温で、図３（ａ）に示すように最上層内部電極に沿ったクラックが発生した。

【００５２】また、試料Ｎｏ．７では、セラミックペーストを内部電極パターン間に完全に充填しており、内部電極の両側に湾曲部が発生しなかった。この場合、焼成時のセラミックペーストと内部電極パターンにおける収縮率の差異から、積層方向中央部に内部応力が発生し、耐熱衝撃試験にて比較的低温で、図３（ｂ）に示すように、積層方向中央部の内部電極に沿ってクラックが発生した。

【００５３】

【発明の効果】以上詳述したとおり、本発明によれば、容量発生部のいずれか一方に形成された容量非発生部の内部電極に湾曲部が形成されているため、電子部品本体内部に発生する内部応力発生を抑制して耐熱衝撃性を向上し、電子部品本体の積層方向中央部の内部電極に沿ったクラック発生を抑制できるとともに、最外層の内部電極に沿ったクラック発生を抑制できる。

【図面の簡単な説明】

【図１】本発明の積層型電子部品を示す断面図である。

【図２】（ａ）～（ｃ）は本発明の積層型電子部品の製造工程を説明するための工程図であり、（ｄ）はプレス後に内部電極パターンが湾曲する状況を説明する説明図である。

【図３】試料Ｎｏ．１、７のクラック発生位置を示す説明図である。

【図４】従来の積層型電子部品を示す断面図である。

【符号の説明】

３１・・・誘電体層

３３・・・内部電極

9

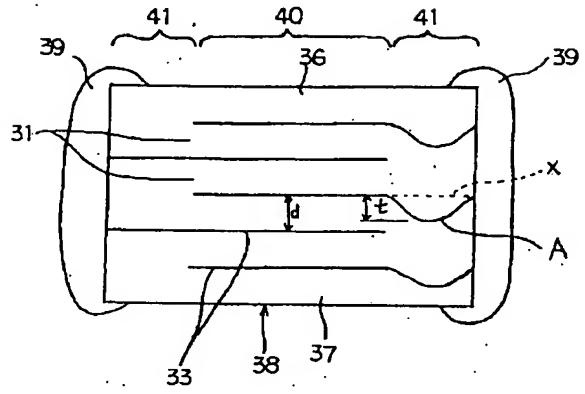
３９・・・外部電極
４０・・・容量発生部
４１・・・容量非発生部

10

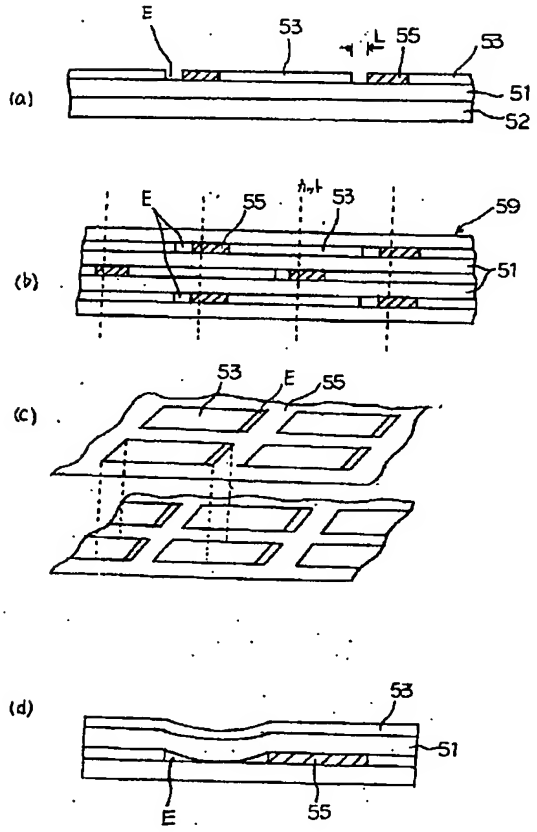
＊Ａ・・・湾曲部
Ｘ・・・内部電極の延長線

＊

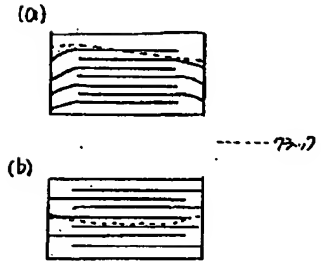
【図１】



【図２】



【図３】



【図４】